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Uncovering the hidden population of symbiotic stars

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Symbiotic stars are interacting binary systems consisting of a companion star, usually a white dwarf, and a primary star, usually a red giant. In general, there are two phases of symbiotic stars: accreting- only and burning-type. There are several hundred known symbiotic systems, most of which are in the burning phase, but that is due to an observational bias. In the burning-type case, we observe a strong nebular continuum and a rich emission line spectrum, so systems in this phase can be easily detected at optical wavelengths. In order to determine the significance of symbiotic stars, we need to characterize and quantify the entire population in the Galaxy. Furthermore, we assume that symbiotic stars spend most of their lives in the accreting-only phase. These systems are difficult to detect because the optical spectrum is dominated by the red giant and there are no or only very weak emission lines present.

One of our goals is to separate symbiotic stars which contain AGB or RGB giant as a primary star. The most promising approach we tried is looking for IR excess. We think we found a good independent indication of AGB versus RGB in the form of a W3-W4 color index. We are interested in light curve deviations in IR which can be a consequence of heated dust around a star. A similar kind of IR excess can be seen in AGB stars which lost a lot of mass due to their evolution. We are exploring ways of connecting photometric detection of AGB stars with their spectra. If we are successful we will be able to search for AGB and RGB distinction based on their spectra from large surveys such as GALAH, Gaia-ESO and in the future 4MOST.

We will extend our research to other color indices and first use an unsupervised machine learning technique for clustering, e.g. t-distributed stochastic neighbor embedding (tSNE), which is a dimensionality reduction technique. This provides a larger training set for a supervised machine learning method, e.g. Random Forest, which can be used in future identifications of such systems (see also Akras et al, 2019).

The accretion of stellar wind from the red giant onto the surface of the white dwarf makes symbiotic stars a promising Type Ia supernova progenitor. Because of the novae outbursts, they are considered to be one of the candidates responsible for the enrichment of the interstellar medium with lithium.

Session

Stellar observations (photometry and spectrometry)

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